PRELIMINARY STUDIES ON THE FLAVOR AND QUALITY OF FRESH N. C. BLUE CRAB MEAT

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INTRODUCTION

In recent years there has been a phenomenal rise in the production of meat from the blue crab (Callinectes sapidus) in North Carolina. In Pamlico county alone over one million pounds of picked crab meat were produced last year from six processing plants. At present there is no standardization of procedure in cooking the crabs and consequently the quality of the product varies a great deal from season to season and from plant to plant. Since almost all of the meat is sold on ice as fresh product the lack of uniform quality makes it imperative that the product reach the consumer in the shortest possible time. Failure to do this can result in spoilage of the meat to such a degree as to make it unfit for consumption.

After crab meat is pasteurized it can be stored at 33-37°F and still be completely satisfactory after six months storage. Five plants in N. C. are equipped to pasteurize crab meat and it would be beneficial to the entire industry in North Carolina if it was made possible for every producer to have his product pasteurized.

A study was undertaken to establish optimum processing conditions for the pasteurization of N. C. blue crab meat commencing in September 1964. The intent was to determine the cooking and pasteurization conditions which would best preserve the flavor and texture of the crab meat and yield a product which would be satisfactory from the microbiological standpoint. This report summarizes in part, the investigations of the first year of the project. Most of the microbiological work has already been reported in Special Scientific Report No. 6 (October, 1965).

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*Distribution of this report does not constitute publication. The data contained herein are preliminary and are subject to correction and/or revision.

The investigations can be subdivided as follows:

1. Organoleptic evaluations
   a. Procedures
   b. Pure chemicals
   c. Crab meat
2. Microbiological Studies

METHODS

1. Organoleptic evaluations.

a. Procedures.

In order to determine the effect of various cooking and pasteurization treatments on the flavor of crab meat it was necessary to train a group of individuals in taste panel technique. The individuals recruited for the panel were technicians in this department and students with an interest in food science. Of a total of thirty-one participants seventeen took part in more than a third of the flavor evaluation sessions. The remainder dropped out because of in ability to discriminate, lack of interest or inability to attend regularly.

During the sessions the panelists were seated in a booth designed to hold four people in such a manner that they could individually evaluate the samples without outside interference or distractions. Running water and a sink for the disposal of wastes were available in each unit of the booth. No time limit was set for an evaluation and the panelists were instructed to attempt to judge the products as honestly and impartially as possible. The samples under test were given code letters or numerals and the judgements were recorded by the participants on score sheets.

In order to familiarize the panelists with tasting procedures and some of the characteristic tastes, aqueous solutions of pure chemicals were evaluated first, followed later by samples of crab meat.

b. Pure chemicals.

The chemicals used in these tests were selected to acquaint the panelists with tastes that they might encounter with crab meat in the hope that they might later be in a position to give meaningful descriptions

of the flavors of different samples of crab meat. Aqueous solutions of sucrose, tartaric acid, sodium chloride and trimethylamine hydrochloride were used as being indicative of sweetness, sourness, saltiness and fishiness respectively.

A threshold value was determined for each compound. This value is the concentration at which more than fifty percent of the participants could detect the compound when compared with pure water. The results are shown in Table 1. The table also shows the smallest detectable differences for two concentrations of the same compound. The latter values were determined by means of triangle difference tests and two-sample difference tests. Statistically they are very highly significant for sucrose and sodium chloride and highly significant for tartaric acid. It was not possible to determine the smallest detectable difference for trimethylamine because the panelists could not taste other solutions after tasting one sample of trimethylamine. All the results shown in Table 1 are very close to the values obtained by other workers and it was concluded that the taste panel was functioning in a normal manner.

c. Crab meat.

In the evaluation of crab meat the triangle difference test was used exclusively. In this test three samples are presented of which two are identical and the third one is different. The panelist is asked to identify the odd sample. The samples were coded with numerals or letters that are considered to be psychologically pure, i.e. they give no added connotation to the sample. Examples of such codes are K, P and S; L, T and R; 67, 34 and 85; and 52, 16 and 41. A sample of a score sheet for a triangle test is appended to this report. The crab meat samples were kept at a constant temperature of 75°F and the panelists were required to rinse out their mouths with distilled water at room temperature between samples. All samples were shredded to the same degree to reduce the effect that texture might have on the results. Table 2 shows the results of comparisions of fresh crab meat of the three standard grades. In each case the pair under test came from the same source.

From the results it is clear that there is a distinct difference in flavor between claw meat and backfin meat and between claw meat and special meat. Except for one case all the results are very highly significant (i.e. above the 0.1% level of probability). On the other hand the comparison of backfin and special meats gave no clear pattern of results.

When fresh and pasteurized crab meats were compared it was found that the backfin meats and claw meats were different to the extent of being very highly significant. No significant difference was found between fresh and pasteurized special meat. The results are shown in Table 3. In each case the paired samples came from the same plant. The fresh samples were two days old and the pasteurized samples eight days old. In the case of the samples evaluated on June 23 it is interesting to note that backfin and claw samples yielded very highly significant differences and yet the special samples which came from the same lots of crab meat did not show a difference. Much further testing would be required to estimate the significance, if any, of this observation.

The panel was also used to evaluate a sample of canned (cooked) blue crab meat. When compared with fresh or with pasteurized meats every panelist was able to select the odd sample. This was true both for backfin and for special meats. Claw meat was not available.

2. Microbiological studies.

In addition to the studies reported in Special Scientific Report No. 6 an attempt was made to inhibit bacterial action with a chelating agent on the assumption that this agent would bind the metallic cations required for the growth of bacteria. Both ethylenediamine tetraacetic acid (EDTA) and a combination of EDTA and citric acid were tested. The compounds were added in solution to the blended crab meat prior to plating in an attempt to inhibit colony formation on the plates. No inhibitory action was found when EDTA was added at the Food and Drug Administration limit of 275 ppm. EDTA and citric acid were also added in quantities calculated to bind all the calcium, potassium and iron in the crab meat with a 25% excess and again no inhibition of bacterial growth was observed.

DISCUSSION

Although the original aim of this study has not been achieved a considerable amount of useful information has been accumulated. This is particularly so on the microbiology of blue crab as detailed in Special Scientific Report No. 6. The experimental results in that report show that a satisfactory microbiological procedure was developed which could be used to follow the spoilage and predict the shelf-life of crab meat stored at refrigeration temperatures.

Organoleptic studies showed that an acceptable taste panel could be trained and that it could distinguish between fresh crab meat and commercially pasteurized crab meat. Although microbiological data were available for some of the crab meat samples evaluated by the taste panel, there was not enough of this information to assess the ability of the panel to judge the freshness of the meat. For future work the authors recommend that a small (6-10 people) highly trained panel be used because it was found that the larger group was difficult to get together at one time due to changes in campus timetables and examinations.

In future work it would also be desirable to obtain the crab meat from one source and to carry out all the processing at that plant or alternatively transport all the meat to Raleigh for processing and evaluation. This was not done in this study because the investigators wanted to evaluate the products from the several plants in the State and because the facilities and labor were not available for such an undertaking. It should also be noted that only the flavor and microbiological quality of crab meat was studied and that to produce an acceptable product for the consumer consideration must also be given to the effects that cooking and pasteurization have on the color and texture of the meat.

The authors do not plan to continue this work at present for several reasons. After this study commenced a report from the University of Maryland revealed that work of a similar nature was nearing completion at their seafood laboratory in Crisfield. Thus to avoid duplication of effort and to benefit from this work it would be wise to await the publication of their results. In addition this study has now reached the stage where controlled pasteurization studies should be initiated. Unfortunately the overcrowded conditions of our present facilities would not permit a satisfactory program of pasteurization to be carried out at this time. Therefore it is recommended that renewal of this project be considered in 1967 when this department expects to be housed in a new and larger building on the campus and when hopefully the results of the Crisfield investigations will be available.

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Table 1.

Threshold values and detectable difference values for pure chemicals in water.

Chemical	Flavor Sensation	Threshold value in water	Solutions with a detectable difference
		percent	percent
Sucrose	sweet	0.125	0.5 and 1.0
Tartaric acid	sour	0.005	0.01 and 0.015
Sodium chloride	salty	0.025	0.25 and 0.35
Trimethylamine	fishy	0.00125	--

Table 2.

Results of triangle difference tests on pairs of crab meat grades.

Date	Age of crab meat, days	Number of panelists	No. of correct judgements	Statistical significance
(a) backfin vs. special				
25 Feb 1965	4	18	7	none
8 Mar 1965	5	17	6	none
9 Mar 1965	6	16	2	none
11 Mar 1965	7	17	11	highly significant
22 Apr 1965	1	32	10	none
29 Apr 1965	4	22	11	none
29 Apr 1965	7	11	7	significant
18 May 1965	4	24	17	very highly significant
20 May 1965	3	10	6	none
27 May 1965	3	18	12	highly significant
10 Jun 1965	2	26	17	very highly significant
19 Aug 1965	3	26	12	none
(b) backfin vs. claw				
11 Mar 1965	8	17	14	very highly significant
25 Mar 1965	1	15	9	significant
22 Apr 1965	1	16	14	very highly significant
20 May 1965	3	10	10	very highly significant
(c) claw vs. special				
11 Mar 1965	8	17	14	very highly significant
22 Apr. 1965	1	16	15	very highly significant
20 May 1965	3	10	10	very highly significant

Table 3

Results of triangle difference tests on fresh and pasteurized crab meat.

Date	Number of panelists	No. of correct judgements	Statistical significance
(a) backfin			
25 Mar 1965	15	14	very highly significant
23 Jun 1965	26	18	very highly significant
(b) special			
23 Jun 1965	22	10	none
(c) claw			
23 Jun 1965	24	14	significant
24 Jun 1965	22	16	very highly significant

Name: _____

Date: _____

Test No. _____

Any of these samples may or may not be different from the other two. Please taste the samples and check one of the following categories:

☐ Samples are different

The odd Sample is sample _____.

☐ Samples are not different.

☐ No decision (all samples taste different).

Name: _____

Date: _____

Test No. _____

Any of these samples may or may not be different from the other two. Please taste the samples and check one of the following categories:

☐ Samples are different.

The odd Sample is sample _____.

☐ Samples are not different.

☐ No decision (all samples taste different).